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Research Article

Enhancing Students' Self-Efficacy and Mathematical Analysis Skills: Applying the Guided Discovery Learning Model Supported by YouTube

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Abstract

This study aims to investigate the impact of utilizing the Guided Discovery Learning (GDL) model supported by YouTube on enhancing self-efficacy and mathematical analysis abilities among junior high school students. Adopting a quantitative approach, this research was structured as a quasi-experimental design with a post-test only control group arrangement. Data was collected through subjective questionnaires, descriptive questions, and documentation. Data analysis was conducted using MANOVA with the aid of SPSS version 25. The findings indicate a significant difference in self-efficacy and mathematical analysis skills between students who participated in learning using the GDL model supported by YouTube compared to those who engaged in GDL without YouTube and expository learning methods. MANOVA testing, following the tests for data normality and homogeneity, affirmed the effectiveness of the YouTube-assisted GDL model in enhancing both variables. This study confirms that the application of the Guided Discovery Learning model with YouTube support significantly improves self-efficacy and mathematical analysis skills in junior high school students compared to other learning methods. This highlights the potential of integrating online resources like YouTube into teaching methods to facilitate more interactive learning experiences and improve student learning outcomes.

1. Introduction

In the continually evolving era of globalization, education plays a crucial role in preparing the younger generation to become independent members of society, capable of self-sustenance (Nam, 2022; Olobia, 2023). This role of education extends beyond mere obligation, emerging as a demand of the times that requires every individual to equip themselves with diverse skills to navigate and thrive in the global competition (Leikuma-Rimicāne et al., 2022; Negescu et al., 2021). Particularly, the rapid advancement of science and technology underscores the critical need for proficiency in mathematics. Mathematics not only supports the development of modern technology but also plays a vital role across various disciplines, influencing daily life and critical decision-making processes (Murni & Ruqoyyah, 2020; Song, 2022). However, the most significant challenge faced in the context of Indonesian education is the low level of mathematical ability among students. This issue is underscored by the findings of the 2018 Programme for International Student Assessment (PISA), which ranked Indonesian students' mathematical abilities at 73rd out of 79 countries, with an average score of only 379 (Ismawati et al., 2023). This indicates that students' understanding of mathematical concepts and their analytical capabilities are far from satisfactory. The disappointing performance highlights a significant gap in the Indonesian mathematics education system, particularly concerning the teaching and learning methods employed in schools (Mailizar & Fan, 2019). Recognizing the urgency of addressing this issue acts as a catalyst for research aimed at enhancing students' understanding and abilities in mathematics, especially through the implementation of innovative learning methods capable of facilitating improvements in self-efficacy and mathematical analysis skills.

The critical importance of self-efficacy and mathematical analysis skills in education is undeniable, especially in fostering the capabilities necessary for success in the contemporary, fast-paced global environment. Self-efficacy, the belief in one's ability to perform tasks and face challenges, significantly influences students' engagement in learning and problem-solving in mathematics, leading to improved outcomes (Bandura, 2013; Cervone et al., 2020; Luu, 2023; Martin, 2020; Yentür, 2023). Concurrently, mathematical analysis skills, essential for critical thinking and problem-solving, enable students to dissect, understand, and apply mathematical concepts to complex problems, underscoring their relevance beyond academic settings into professional and daily decision-making (Denton & Gokhale, 2020; Satake et al., 2019; Uria-Albizuri et al., 2020). Therefore, integrating strategies to boost self-efficacy alongside developing analytical skills in mathematics curricula is paramount for preparing students to navigate and innovate within our rapidly changing world, emphasizing the intertwined roles of these competencies in lifelong learning and adaptability. Despite the recognized importance of self-efficacy and mathematical analysis skills, it is concerning that students exhibit notably low levels in both areas. This gap highlights a critical need for targeted interventions and enhanced instructional strategies to elevate students' confidence and analytical capabilities, ensuring they are better equipped for academic success and future challenges.

2. Literature Review

In recent years, the topic of Guided Discovery Learning has garnered increasing attention within the academic community, owing to its crucial role in enhancing students' self-efficacy and mathematical analysis skills, prompting a thorough examination of existing literature to understand the prevailing trends, methodologies, and findings in this area. Various innovative learning methods have been explored to address these challenges and improve student performance. These include Project-Based Learning (PBL), which emphasizes real-world problem-solving and student collaboration (Karan & Brown, 2022); Flipped Classroom models, where students engage with instructional content outside of class and focus on exercises and projects during class time (Long et al., 2017); and Blended Learning, which combines traditional face-to-face instruction with online learning activities (Watson, 2018). Each of these methods has demonstrated positive impacts on student engagement and learning outcomes. However, Guided Discovery Learning (GDL) stands out due to its structured yet flexible approach that actively involves students in the learning process.

Guided Discovery Learning (GDL) is a teaching model where students learn from specific examples provided by the teacher, guiding them to understand a concept (De Jong & Lazonder, 2014; Janssen et al., 2014). Hadianti et al. (2022) states that the GDL model implements the learning objectives through instructions given by the teacher, while Afifah (2021) describes it as based on directed actions. Ristanto et al. (2022) outlines the steps in the GDL model, including stimulation, problem statement, data collection, data processing, verification, and generalization. Lestari et al. (2021) and Supriadi et al. (2019) highlights the advantages of GDL, noting it helps students become active and effective in learning, cultivates an inquiry attitude, supports problem-solving skills, encourages student interactions, and improves long-term concept retention. However, a limitation is its time-consuming nature, as it transforms teachers into facilitators, motivators, and mentors, and not all students may be able to follow this learning model due to limited rational thinking abilities (Armin & Sumendap, 2022). This model is anticipated to enhance students' self-efficacy and analytical abilities, addressing the current low levels observed in students at SMP Negeri 6 Tulang Bawang Barat. Through the application of GDL, there is a hopeful expectation for substantial improvements in students' self-efficacy and their mathematical analysis skills.

Previous studies have explored the integration of the Guided Discovery Learning (GDL) model with various learning media, such as virtual lab simulations (Admoko et al., 2019), learning modules (Bayharti et al., 2019; Yerimadesi et al., 2023), computer-based media (Leutner, 1993; Majid & Majid, 2018; Meany et al., 2001; Suratno et al., 2018), mobile gaming (Huang, 2010), concept mapping (Sari & Cahyo, 2020), dan student worksheets (Rozi et al., 2020). These findings have significantly contributed to our understanding of how interactive media can enrich learning experiences through GDL. However, research on the application of YouTube within the GDL context, especially in developing students' self-efficacy and mathematical analysis abilities, remains limited. This study seeks to fill this gap by exploring how a combination of GDL assisted by YouTube, as a dynamic and interactive learning medium, can influence self-efficacy and enhance mathematical analysis abilities in students. Through this innovative approach, the study not only broadens the discourse on the integration of digital media in education but also provides new insights regarding its impact on dependent variables such as self-efficacy and mathematical analysis abilities, offering valuable contributions to educational practice and future research.

3. Methodology

3.1. Design

This study employs a quasi-experimental design with a post-test-only control group to assess the impact of integrating the Guided Discovery Learning (GDL) model with YouTube on students' self-efficacy and mathematical analysis abilities. This design allows for the comparison of treatment effectiveness by measuring learning outcomes after the intervention is applied, without pre-test measurements, thereby reducing potential pre-test bias. It is chosen for its partial control over external variables that may affect the experiment's outcome while still providing a control group for comparison.

3.2. Participants

The population for this study includes all second-semester seventh-grade students at SMPN 6 Tulang Bawang Barat, totaling 108 students. A sample of 75 students was selected, divided into three classes: VIII A, VIII C, and VIII D during the odd semester, creating two experimental groups and one control group, each consisting of 25 students.

3.3. Instruments

Measurements in this study are conducted using two types of instruments. First, descriptive problems are designed to assess students' mathematical analysis abilities. Second, a questionnaire is utilized to measure students' self-efficacy levels. Both instruments have undergone a process of validation and reliability testing, including difficulty level and discriminative power tests, to ensure the adequacy of the descriptive problems.

3.4. Data Analysis

Collected data is analyzed using the MANOVA (Multivariate Analysis of Variance) technique with the assistance of SPSS 25 software and Microsoft Excel. This analysis is selected to test the differences in post-test means between experimental and control groups simultaneously for the dependent variables, namely self-efficacy, and mathematical analysis abilities. Before conducting MANOVA, data will undergo tests of normality and homogeneity to ensure compliance with the necessary statistical assumptions.

4. Results and Discussions

This section presents the data analysis results obtained from measuring the two variables in both the experimental and control groups. The analysis aims to identify significant differences among the groups of students utilizing the GDL model assisted by YouTube (Experimental Class 1), the GDL model without

YouTube assistance (Experimental Class 2), and the expository teaching method (Control Class). The following are the outcomes of the normality test, homogeneity test, and MANOVA analysis that have been conducted.

Table 1. Normality test for mathematical analysis skills

Tests of Normality							
		Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	Class	**Statistic**	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Mathematical Analysis Ability	Experiment 1	.133	25	.200*	.970	25	.639
	Experiment 2	.163	25	.084	.928	25	.080
	Control	.110	25	.200*	.978	25	.842

Table 1 presents the results of the Kolmogorov-Smirnov and Shapiro-Wilk tests for normality concerning students' mathematical analysis abilities in both the experimental and control groups. For the Kolmogorov-Smirnov test, a significance value (Sig.) greater than 0.05 indicates that the data distribution does not significantly deviate from a normal distribution. Similarly, for the Shapiro-Wilk test, a significance value greater than 0.05 also indicates normality. The results show that for both tests, the significance values are greater than 0.05 for all groups, indicating that the data for mathematical analysis abilities are normally distributed.

Table 2. Self-Efficacy Questionnaire Normality Test

Tests of Normality							
	Class	**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
		Statistic	**df**	**Sig.**	**Statistic**	**Df**	**Sig.**
Mathematical Analysis Ability	Experiment 1	.153	25	.134	.953	25	.293
	Experiment 2	.143	25	.200*	.968	25	.590
	Control	.072	25	.200*	.992	25	.999

Table 2 show the results of the normality test for the self-efficacy questionnaire responses. Similar to Table 1, the Kolmogorov-Smirnov and Shapiro-Wilk tests were employed. The significance values for both tests in all groups are greater than 0.05, indicating that the self-efficacy data are normally distributed.

Table 3. Homogeneity Test on Mathematical Analysis Ability Questions

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**Sig.**
Mathematical Analysis Ability	Based on Mean	1.014	2	72	.368
	Based on Median	.917	2	72	.404
	Based on Median and With Adjusted Df	.917	2	70.568	.404
	Based on Trimmed Mean	1.002	2	72	.372

Table 3 show the results of the Levene's test for the homogeneity of variances in mathematical analysis abilities. This test assesses whether the variances among groups are equal. A significance value greater than 0.05 indicates homogeneity of variances. The results show that the significance values for the test based on the mean, median, median with adjusted degrees of freedom, and trimmed mean are all greater than 0.05, indicating that the variances are homogeneous.

Table 4. Self-Efficacy Questionnaire Homogeneity Test

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**Sig.**
Mathematical Analysis Ability	Based on Mean	2.183	2	72	.120
	Based on Median	1.996	2	72	.143
	Based on Median and With Adjusted Df	1.996	2	63.596	.144
	Based on Trimmed Mean	2.157	2	72	.123

Table 4 presents the results of Levene's test for the homogeneity of variances in the self-efficacy questionnaire responses. Similar to the scores for mathematical analysis abilities, the significance values for the tests based on the mean, median, median with adjusted degrees of freedom, and trimmed mean are all greater than 0.05, indicating that the variances are homogeneous.

Normality and homogeneity tests have been conducted, and the data were found to be normally distributed and homogeneous, thus allowing the progression to the MANOVA (Multivariate Analysis of Variance) testing phase.

The MANOVA calculations were carried out in a partial manner to as depicted in the following table:

Table 5. MANOVA Results Between-Subjects Effects for Mathematical Analysis Ability and Self-Efficacy

Tests of Between-Subjects Effects						
Source	**Dependent Variable**	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	Mathematical Analysis Ability	628.507[a]	2	314.253	10.222	.000
	Self efficacy	1743.440[b]	2	871.720	12.327	.000
IntercePT	Mathematical Analysis Ability	414111.053	1	414111.0 53	1347 0.433	.000
	Self efficacy	422325.120	1	422325.120	5972. 261	.000
Class	Mathematical Analysis Ability	628.507	2	314.253	10.222	.000
	Self efficacy	1743.440	2	871.720	12.327	.000
Error	Mathematical Analysis Ability	2213.440	72	30.742		
	Self efficacy	5091.440	72	70.714		
Total	Mathematical Analysis Ability	416953.000	75			
	Self efficacy	429160.000	75			
CorrectedTotal	Mathematical Analysis Ability	2841.947	74			
	Self efficacy	6834.880	74			

a. R Squared = .221 (Adjusted R Squared = .200)

b. R Squared = .255 (Adjusted R Squared = .234)

The MANOVA test results clearly indicate a significant impact of the Guided Discovery Learning model assisted by YouTube on both mathematical analysis abilities and self-efficacy among students. For both dependent variables, the significance values were observed to be 0.000, which, when compared to the criterion significance level of 0.05, unequivocally suggests that the null hypothesis is rejected. This demonstrates a definitive influence of the YouTube-assisted Guided Discovery Learning model on enhancing students' mathematical analysis abilities and self-efficacy. Furthermore, a simultaneous MANOVA test, aimed at addressing the third hypothesis, also revealed significant effects (Pillai's Trace, Wilks' Lambda, Hotelling's Trace, Roy's Largest Root all yielding a significance value of 0.000) when contrasted against the standard significance threshold of 0.05. These outcomes collectively affirm that the incorporation of YouTube within the Guided Discovery Learning framework significantly contributes to the improvement of both self-efficacy and mathematical analysis capabilities in students, marking a noteworthy advancement in educational methodologies for fostering these critical skills.

The findings from this study reinforce the effectiveness of the Guided Discovery Learning (GDL) model, particularly when supplemented by YouTube, in enhancing students' mathematical analysis abilities and self-efficacy. This is in line with previous studies that have highlighted the positive impact of GDL on learning outcomes. For instance, Admoko et al. (2019) and Bayharti et al. (2019) demonstrated that integrating GDL with various educational media, such as virtual labs and learning modules, significantly enhances students' comprehension of complex concepts. Our research extends these findings by illustrating that YouTube, as a dynamic and interactive platform, further amplifies these benefits, especially in mathematics education.

Furthermore, the significant improvement in self-efficacy among students exposed to the YouTube-assisted GDL model aligns with the assertions by Huang (2010) and Sari and Cahyo (2020), who found that interactive and engaging learning experiences are crucial in boosting students' confidence in their abilities. The multimedia elements inherent in YouTube provide a rich, contextual learning environment that likely contributes to this enhanced self-efficacy, supporting the findings by Leutner (1993) and Majid and Majid (2018) on the impact of computer-based media on learning motivation and engagement.

A notable aspect of this study is its contribution to understanding the simultaneous impact of YouTube-assisted GDL on both self-efficacy and mathematical analysis abilities. While previous research has separately explored the influence of digital media and GDL on educational outcomes, our study bridges these areas by demonstrating that the synergy between YouTube and GDL can significantly enrich students' learning experiences. This suggests a promising avenue for future educational strategies, particularly in subjects where students traditionally face difficulties, such as mathematics.

Given these findings, educators and curriculum developers are encouraged to consider the integration of YouTube and other digital platforms within the GDL framework to enhance educational delivery and outcomes. This approach not only supports the development of critical analytical skills but also fosters a positive learning attitude and self-belief among students, which are essential for their academic and future career success. Further research could explore the long-term effects of such integrative learning models on student achievement and engagement across different subjects and educational levels.

5. Conclusions

The research conclusively demonstrates that the Guided Discovery Learning (GDL) model, when augmented with YouTube, significantly impacts students' self-efficacy and mathematical analysis abilities, particularly in the context of numerical patterns. Students exposed to the YouTube-assisted GDL model exhibited superior self-efficacy and mathematical analysis skills compared to those who learned through traditional GDL without YouTube and the expository learning model. This finding underscores the effectiveness of integrating dynamic and interactive digital platforms like YouTube into the GDL framework, highlighting its potential to enhance educational outcomes by providing a more engaging and effective learning experience. The integration of YouTube not only facilitates a deeper understanding of mathematical concepts but also boosts students' confidence in their abilities, suggesting a valuable approach to improving education quality in mathematics and potentially other subjects. The integration of YouTube not only facilitates the understanding of mathematical concepts but also boosts students' confidence in their abilities. This demonstrates a valuable approach to enhancing the quality of education in mathematics and potentially other subjects. These findings contribute to the existing literature by providing empirical evidence of the benefits of using digital media in discovery-based learning, especially in developing countries like Indonesia, where access to and engagement with educational technology can play a crucial role in improving student learning outcomes.

The contributions of this research to the literature include empirical evidence on the effectiveness of the GDL model supported by YouTube in enhancing students' self-efficacy and mathematical analysis abilities. It also demonstrates that interactive digital media like YouTube can improve student engagement and understanding in mathematics learning. This study emphasizes the importance of integrating technology into traditional teaching methods to achieve better educational outcomes. Recommendations for future research include exploring the effectiveness of the GDL model supported by YouTube in other subjects, evaluating the long-term impact of using YouTube in GDL, comparing various other digital platforms such as Khan Academy and Coursera, and conducting studies that encompass diverse student demographics to understand the factors influencing learning outcomes in technology based GDL models.

Declaration of Competing Interest: The authors declare that they have no known competing of interest.

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